REMOT project

Report on Astronomic Telescope Remote Operation Demonstration Testing

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D11.1: REPORT ON ASTRONOMIC TELESCOPE REMOTE OPERATION DEMONSTRATION TESTING

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1. INTRODUCTION

The remote access to the TNG Control System, following a generalized approach, has been demonstrated to be feasible (within some limits) in the context of the REMOT project, by connecting the Telescope Control System software to teh Teleoperation System software produced by the TCP Sistemas e Ingenieria of Madrid.

This has produced some enhancements in the communications handling, and has led to the tracing of some conclusions, which, if summarized, can be split into two main points of interest:

- the teleoperation of scientific experiments is feasible, but a generalized approach is possible only at the architectural level;
- some inprovements have to be made on the Demonstrator to profitably produce a "real" Teleoperation System.

In the following sections, the description of the Tests performed and some evaluation of the work produced in the context of the REMOT project, will be presented.

2. DESCRIPTION OF THE ENVIRONMENT FOR THE TEST

The test performed at the Demo Pilot for the REMOT project has been demonstrated by providing a Remote Control Software to a Remote User standing at the TAP conference held in Barcelona on 5th, 6th, 7th/02/1998, and connected to the TNG Control System Software running at the TNG office located at Santa Cruz de La Palma, Canary Islands, Spain.

This software, installed on 2 pentium PCs, running the Windows NT 4.0 operating system, was CORBA based and was comprising the following characteristics:

- the Teleoperation System, developed by TCP Systemas e Ingenieria (from Madrid), has been designed in order to improve the quality of service of the communications as well as to control and directly manage the band allocation and the network traffic;
- at the client side, a PC running the Teleoperation System software and providing a static Remote User Interface has been used in order to remotely access the TNG Control System;
- at the server side, another part of the Teleoperation System software (running on another PC, installed at the TNG LAN), has been used to collect the information sent through the communications channel and to make it accessible and understandable to the TNG Control System;
- at both the client and server sides, a videoconference software has been installed on the other 2 PCs;
- the communications channel has been handled with the ISDN technology.

In order to make the exchange of data (between the Teleoperation System and the TNG Control System) possible, a particular process (which we named the Communications Ancillary Process), has been added to the TNG software and used to translate the data, as understandable in the Galileo environment, into data written in the Teleoperation System format and vice-versa (this format has been designed in the context of the REMOT project to show that no particular

proprietary information needs to be used, but only a few arrangements have to be made, in order to access a scientific instrument via the Teleoperation System).

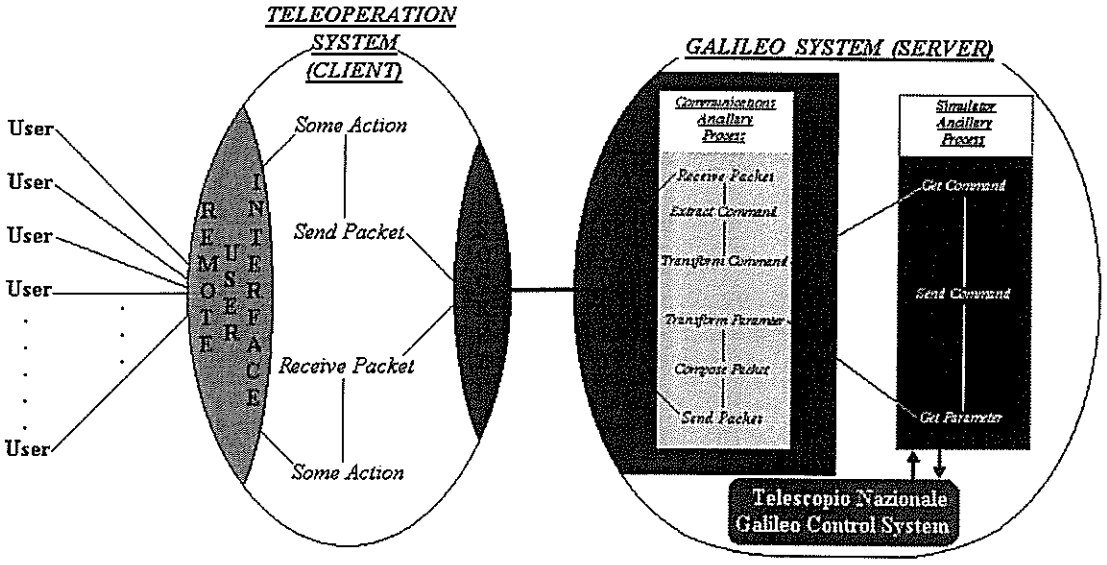

Figure 1: Teleoperation System Integration with the TNG Control System Software

Having this point of view in mind, we can think the Teleoperation System as a tool providing and organizing the communications between the Remote and Local sites, and think at the particular scientific facility (located at the Local site) as the instrument which, by writing a minimum (with respect to the whole experimental setting) software interface, can be made accessible even in the remote fashion.

The whole structure of the test setting can be summarized as shown by figure 1.

3. TEST DEFINITION

Due to the fact that the TNG System was not completely available at the moment of running the tests defined for the Demo Pilot of the REMOT Project, the complete test has been split into two parts:

- a first part, designed in order to test the behavoiur and the quality of the communications, when handled by the Teleoperation System: in this phase, all the instruments of the Telescope and all its functionalities, have been simulated by using a program, which we called a Simulator Ancillary Process, that, while running in the TNG environment and using the TNG libraries and its communications utilities, has been very useful to trace an estimation of the exchange of data between the TNG environment and the "rest of the world"; in this context, every instrument has been substituted with a program which performs the same actions as if it was a real part of the telescope itself;
- a second part, that, for meteorological reasons, but even because of some problems of coordination and cooperation occurred during the realization of the Galileo Project, has not been put at our disposal for the demo date, should have been made up of the part designed to control the Telescope building movements.

Let's now see in more detail how the first test has been designed and executed, and how we were planning to perform the second one.

3.1 TNG Simulation

As stated above, simulation of the TNG behaviour has shown to be practically essential, because of two main reasons:

- first of all, a very important consideration has to be made: the test of every instrument, either hardware or software, that has to be considered as an external tool to be added to the TNG, must be evaluated without the risk of negatively influencing or damaging the TNG environment and its instruments; following this condition, the use of a TNG simulator comes out to be the very basic requisite for any test to be made on the TNG Control System itself, when planning to modify it by adding/removing any facility to/from its environment;

- secondly, being the TNG Telescope still in its fulfilment phase, not all its functionalities can be accessible or usable, at this moment, so they need to be substituted by programs which simulate their behaviour.

This is why we have designed and realized a TNG simulator, which has been used to test the communications with the Teleoperation System while the Remote User was asking to perform the following actions:

1) Ask to access the TNG Control System, and be validated to use the Telescope (Login into the System);
2) Ask to control/monitor the Dome doors opening and closing actions;
3) Ask to control/monitor the Telescope movements (pointing, tracking, ...);
4) Ask to control/monitor the image acquisition via CCD access;
5) Ask to see/save an image acquired during the experiment.

This simulator has been run integrating it into the TNG Control System Software, so using the communications handling part of the Telescope Control System in order to be able to exchange information between the Communications Ancillary Process and the Simulator (to be thought as the Telescope) itself.

3.2 Controlling the movements of the TNG building

Due to the impossibility to act over the entire telescope setting, because of the current status of development of its various instruments, we had concentrated on trying to demonstrate that we can remotely configure and control the building where the Telescope is hosted, thus working at the telescope operator level.

The actions we thought that should have been demonstrated as possible in this phase of the project were the following:

- Raise/Lower the baffle and open/close the mirror cover;
- Open/Close the 2 shutters (even independently one from each other);

- Open/Close the sliding doors or set them to at a predefined position;
- Open/Close the slit shutters and position the wind screen;
- Set the 4 flaps to a desired position.

All these actions should have been verified by connecting the whole system to the videoconference tool provided by the Teleoperation System software, thus being aknowledged in real time on the status of the various parts controlled in the experiment.

As stated above, the meteorological conditions made the preparation of this test impossible, and so we had to renounce to it.

4. TEST RESULTS AND CONCLUSIONS

The Demonstrator has been organized in order to allow several operators, with different privileges, to access the telescope server, thus allowing a team of scientists, from different locations, to collaboratively perform an experiment.

The Demonstrator has been fitted with two additional facilities:

- a communications monitoring system, that graphically displays the current allocation of services to different communications channels;
- a videoconference system, which allows remote operators to videoconference with local operators at the Telescope or to monitor the Telescope itself. The integration of this second tool is a problem, because the available software is generally made up of closed-off-the-shelf applications; furthermore, videoconference is bandwith hungry and this could influence the sharing of communications resources which involve critical real time monitoring and control actions.

The teleoperation demonstrator core only implements the basic functionslities for demonstrating the feasibility of remotely operating

the telescopes, so it's not worth to evaluate its behaviour in the direction of its usability.

In any case it looks like a simple tool, which immediately offers the impression of a facility useful to remotely control the scientific instrumentation.

This all can be summarized in the following considerations:

- the teleoperation concept and the related architecture have been fully demonstrated in the Astronomical field, with positive reactions from the user's point of view;
- some limitations reside in the performance of the available communications infrastructure, and specially in the lack of QoS support in the Internet;
- teleoperation can be considered a valid and interesting concept, though it has to be better evaluated by providing as available some operational prototypes;
- unique teleoperation applications seem to be possible only at the conceptual, abstract level, though some general technical solutions can be shared among different domains;
- even within a particular domain, commonality is limited, because the work of definition of unique, generic models does not seem to be a realistic approach, although some level of standardization seems to be necessary.

5. FUTURE ISSUES

The REMOT project has permitted to demonstate the feasibility of the teleoperation concept and the related architecture.

Now it could be interesting to transform this all into an operational prototype, which should be integrated in a stable manner into the scientific whole instrumentation that is at disposal of a particular domain.

The system can be seen as usable if some enhancements are made to the demonstrator:

- users and resources management is required;
- a support for the operational procedures could be necessary;
- an integration with scientific archives has to be made;
- some security aspects need to be taken into account;
- flexibility and adaptability of the Teleoperation System has to be designed.